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Multidimensional Lithium-Ion Battery Status Monitoring **Lithium-Ion Batteries: Basics and Applications** **Challenges of a Rechargeable Magnesium Battery** **Batteries in a Portable World** Lithium-Ion Batteries *Low-Cost and Scalable Material Designs and Processes for Next-Generation Lithium-Ion Battery Anodes* **Battery Management Systems of Electric and Hybrid Electric Vehicles** Battery Management Systems, Volume II: Equivalent-Circuit Methods **Lithium Ion Battery Failure Detection Using Temperature Difference Between Internal Point and Surface** Lithium-Ion Batteries *Progress in Modeling and Simulation of Batteries* *Na-ion Batteries* **Battery System Modeling** **DIY Lithium Batteries** **Lithium-Ion Batteries and Applications: A Practical and Comprehensive Guide to Lithium-Ion Batteries and Arrays, from Toys to Towns, Volume 2, Applications** **The Hidden Inheritance** *Lithium-Ion Batteries Advanced Model-Based Charging Control for Lithium-Ion Batteries* **Advanced Battery Management Technologies for Electric Vehicles** *Used Battery Collection and Recycling* **All Solid State Thin-Film Lithium-Ion Batteries** *Lithium-Ion Batteries Hazard and Use Assessment* **Lithium-Ion Batteries and Applications: A Practical and Comprehensive Guide to Lithium-Ion Batteries and Arrays, from Toys to Towns, Volume 1, Batteries** **Sodium-Ion Batteries** Advances in Lithium-Ion Batteries **Data Science-Based Full-Lifespan Management of Lithium-Ion Battery** *Material and Structural Designs for Metal Ion Energy Storage Devices* *Functional Membranes for High Efficiency Molecule and Ion Transport* **Lithium-ion Battery Materials and Engineering** *Sodium-Ion Batteries* **Study of Polyethylene Oxide(PEO) as an Ionic Conducting Binder for Li-ion Battery Cathode** Lithium Ion Rechargeable Batteries Lithium-Ion Batteries and Solar Cells Improved Equivalent-circuit Models of Lithium-Ion-Iron-Phosphate Cells **Polymer-Based Separators for Lithium-Ion Batteries** **Handbook on Battery Energy Storage System** **HWM New Technology Batteries Guide** *Fundamentals and Applications of Lithium-ion Batteries in Electric Drive Vehicles* Lithium Batteries

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Modern human civilization depends on the production and utilization of vast quantities of energy. While innovations in technology are generally met with applause, discoveries over the potential catastrophic impacts of our current ways of generating energy on our climate and society have prompted worldwide efforts to mitigate these issues. Although environmentally-friendly and sustainable methods for electricity generation such as solar photovoltaic energy hold promise for solving our energy issues, a complete shift towards renewable energy would require the development of grid-scale energy storage systems due to the intermittent nature of such technology. In addition, the automotive industry is undergoing a complete transformation to electrification in efforts to reduce the environmental impact of vehicles and comply with increasingly stringent regulations, representing yet another urgent need for high-performance energy storage systems. Of all energy storage technologies for potentially enabling grid storage and electric vehicles, lithium-ion batteries are of particular interest due to their rechargeability, high energy and power densities, and energy efficiency. Although lithium-ion batteries are now widely used for a variety of applications, their prohibitively high cost has prevented their application in these crucial technologies. For specific applications such as electric vehicles and portable electronics, lithium-ion batteries have yet to achieve the energy and power density requirements necessary, posing additional barriers. On top of these obstacles, the commercial viability of lithium-ion batteries for these applications depends on the ability to scale up the production processes to satisfy the market need, creating yet another challenge for solving these important issues. While the development of high-capacity anode materials for lithium-ion batteries is a promising route towards enabling these applications, many of the novel designs for such materials are prohibitively expensive or difficult to scale, preventing them from achieving widespread market adoption. In this dissertation, we describe novel materials and processes for producing three high-capacity anode materials of great industry and academic interest: graphene, silicon, and lithium metal. First, we present a novel method for induction heating-mediated synthesis of freestanding anodes for improving the scalability of traditional chemical vapor deposition processes through reduced process downtimes while enabling higher energy and volumetric densities in lithium-ion batteries by virtue of the freestanding nature of the electrode design, reducing the mass and volume of electrochemically-inactive components. Next, we describe a method for the production of silicon/PVA/graphite composite anodes with long cycling life through the use of a 1-step ball milling method utilizing low-cost precursors for scalable production of high-capacity anode materials. Finally, we reveal a design for air-stable lithium metal hosts fabricated from a scalable powder metallurgic approach, which allows for the fabrication of high-performance lithium metal batteries compatible with existing infrastructure, circumventing the need for a high-cost assembly in an inert atmosphere. Lithium-ion batteries are widely used for portable electronics due to high energy density, mature processing technology and reduced cost. However, their applications are somewhat limited by safety concerns. The lithium-ion battery users will take risks in burn or explosion which results from some internal components failure. So, a practical method is required urgently to find out the failures in early time. In this thesis, a new method based on temperature difference between internal point and surface (TDIS) of the battery is developed to detect the thermal failure especially the thermal runaway in early time. A lumped simple thermal model of a lithium-ion battery is developed based on TDIS. Heat transfer coefficients and heat capacity are determined from simultaneous measurements of the surface temperature and the internal temperature in cyclic constant current charging/discharging test. A look-up table of heating power in lithium ion battery is developed based on the lumped model and cyclic charging/discharging experimental results in normal operating condition. A failure detector is also built based on TDIS and reference heating power curve from the look-up table to detect aberrant heating power and bad parameters in transfer function of the lumped model. The TDIS method and TDIS detector is validated to be effective in thermal runaway detection in a thermal runway experiment. In the validation of thermal runway test, the system can find the abnormal heat generation before thermal runaway happens by detecting both abnormal heating power generation and parameter change in transfer function of thermal model of lithium ion batteries. The result of validation is compatible with the expectation of detector design. A simple and applicable detector is developed for lithium ion battery catastrophic failure detection. A theoretical and technical guide to the electric vehicle lithium-ion battery management system Covers the timely topic of battery management systems for lithium batteries. After introducing the problem and basic background theory, it discusses battery modeling and state estimation. In addition to theoretical modeling it also contains practical information on charging and discharging control technology, cell equalisation and application to electric vehicles, and a discussion of the key technologies and research methods of the lithium-ion power battery management system. The author systematically expounds the theory knowledge included in the lithium-ion battery management systems and its practical application in electric vehicles, describing the theoretical connotation and practical application of the battery management systems. Selected graphics in the book are directly derived from the real vehicle tests. Through comparative analysis of the different system structures and different graphic symbols, related concepts are clear and the understanding of the battery management systems is enhanced. Contents include: key technologies and the difficulty point of vehicle power battery management system; lithium-ion battery performance modeling and simulation; the estimation theory and methods of the lithium-ion battery state of charge, state of energy, state of health and peak power; lithium-ion battery charge and discharge control technology; consistent evaluation and equalization techniques of the battery pack; battery management system design and application in electric vehicles. A theoretical and technical guide to the electric vehicle lithium-ion battery management

system Using simulation technology, schematic diagrams and case studies, the basic concepts are described clearly and offer detailed analysis of battery charge and discharge control principles Equips the reader with the understanding and concept of the power battery, providing a clear cognition of the application and management of lithium ion batteries in electric vehicles Arms audiences with lots of case studies Essential reading for Researchers and professionals working in energy technologies, utility planners and system engineers. The topics of interest in this book include significant challenges in the BMS design of EV/HEV. The equivalent models developed for several types of integrated Li-ion batteries consider the environmental temperature and ageing effects. Different current profiles for testing the robustness of the Kalman filter type estimators of the battery state of charge are used in this book. Additionally, the BMS can integrate a real-time model-based sensor Fault Detection and Isolation (FDI) scheme for a Li-ion cell undergoing degradation, which uses the recursive least squares (RLS) method to estimate the equivalent circuit model (ECM) parameters. This book will fully meet the demands of a large community of readers and specialists working in the field due to its attractiveness and scientific content with a great openness to the side of practical applicability. This covers various interesting aspects, especially related to the characterization of commercial batteries, diagnosis and optimization of their performance, experimental testing and statistical analysis, thermal modelling, and implementation of the most suitable Kalman filter type estimators of high accuracy to estimate the state of charge This book provides an overview of functional membranes for efficient ion/molecule transfer and separation. It first presents the design, fabrication, structure, and performance of several kinds of membranes. Then, the application of membrane technology in organic solvent nanofiltration, hydrogen fuel cells, and solid-state lithium batteries is introduced. Furthermore, the book proposes strategies of strengthening the ion/molecular-level separation and transfer process in membrane processes. It also analyzes the development status, existing problems, and optimization methods in the field of membranes and membrane processes. Finally, it highlights the construction strategy of membrane structures, the structure–performance relationships as well as the transfer and separation mechanisms. The target group of this book is academics and researchers in materials science, chemical engineering, biomedical engineering, and other related fields. This open access book comprehensively consolidates studies in the rapidly emerging field of battery management. The primary focus is to overview the new and emerging data science technologies for full-lifespan management of Li-ion batteries, which are categorized into three groups, namely (i) battery manufacturing management, (ii) battery operation management, and (iii) battery reutilization management. The key challenges, future trends as well as promising data-science technologies to further improve this research field are discussed. As battery full-lifespan (manufacturing, operation, and reutilization) management is a hot research topic in both energy and AI fields and none specific book has focused on systematically describing this particular from a data science perspective before, this book can attract the attention of academics, scientists, engineers, and practitioners. It is useful as a reference book for students and graduates working in related fields. Specifically, the audience could not only get the basics of battery manufacturing, operation, and reutilization but also the information of related data-science technologies. The step-by-step guidance, comprehensive introduction, and case studies to the topic make it accessible to audiences of different levels, from graduates to experienced engineers. In the decade since the introduction of the first commercial lithium-ion battery research and development on virtually every aspect of the chemistry and engineering of these systems has proceeded at unprecedented levels. This book is a snapshot of the state-of-the-art and where the work is going in the near future. The book is intended not only for researchers, but also for engineers and users of lithium-ion batteries which are found in virtually every type of portable electronic product. Singapore's leading tech magazine gives its readers the power to decide with its informative articles and in-depth reviews. The handbook focuses on a complete outline of lithium-ion batteries. Just before starting with an exposition of the fundamentals of this system, the book gives a short explanation of the newest cell generation. The most important elements are described as negative / positive electrode materials, electrolytes, seals and separators. The battery disconnect unit and the battery management system are important parts of modern lithium-ion batteries. An economical, faultless and efficient battery production is a must today and is represented with one chapter in the handbook. Cross-cutting issues like electrical, chemical, functional safety are further topics. Last but not least standards and transportation themes are the final chapters of the handbook. The different topics of the handbook provide a good knowledge base not only for those working daily on electrochemical energy storage, but also to scientists, engineers and students concerned in modern battery systems. Sodium-Ion Batteries An essential resource with coverage of up-to-date research on sodium-ion battery technology Lithium-ion batteries form the heart of many of the stored energy devices used by people all across the world. However, global lithium reserves are dwindling, and a new technology is needed to ensure a shortfall in supply does not result in disruptions to our ability to manufacture reliable, efficient batteries. In Sodium-Ion Batteries: Energy Storage Materials and Technologies, eminent researcher and materials scientist Yan Yu delivers a comprehensive overview of the state-of-the-art in sodium-ion batteries (SIBs), including their design principles, cathode and anode materials, electrolytes, and binders. The author discusses high-performance rechargeable sodium-ion battery technology in the contexts of energy, power density, and electrochemical stability for commercialization. Exploring a wide range of literature on the recent progress made by researchers on sodium-ion battery technology, the book provides valuable perspectives on designing better materials for SIBs to unlock their practical capabilities. A thorough introduction to sodium-ion batteries, including their key materials and likely future developments Comprehensive explorations of design principles of electrode materials and electrolytes for sodium-ion batteries Practical discussions of cathode materials for sodium-ion batteries, including transition metal oxides, polyanionic compounds, Prussian blue analogues and organic compounds In-depth examinations of anode materials for sodium-ion batteries, including carbon-based materials, metal chalcogenides, metal alloys, phosphorus and Na metal anodes Perfect for materials scientists, inorganic chemists, electrochemists, and physical chemists, Sodium-Ion Batteries: Energy Storage Materials and Technologies will also earn a place in the libraries of catalytic and polymer chemists. Modeling and simulation of batteries, in conjunction with theory and experiment, are important research tools that offer opportunities for advancement of technologies that are critical to electric motors. The development of data from the application of these tools can provide the basis for managerial and technical decision-making. Together, these will continue to transform batteries for electric vehicles. This collection of nine papers presents the modeling and simulation of batteries and the continuing contribution being made to this impressive progress, including topics that cover: • Thermal behavior and characteristics • Battery management system design and analysis • Moderately high-fidelity 3D capabilities • Optimization Techniques and Durability As electric vehicles continue to gain interest from manufacturers and consumers alike, improvements in economy and affordability, as well as adoption of alternative fuel sources to meet government mandates are driving battery research and development. Progress in

modeling and simulation will continue to contribute to battery improvements that deliver increased power, energy storage, and durability to further enhance the appeal of electric vehicles. The book covers basic theory, progress and applications of sodium-ion batteries. It intoduces the reader to anode, cathode, electrolyte battery materials and properties. It also describes compatibility and stability of the whole battery system. It is a valuable resource for anyone interested in energy storage. Battery System Modeling provides advances on the modeling of lithium-ion batteries. Offering step-by-step explanations, the book systematically guides the reader through the modeling of state of charge estimation, energy prediction, power evaluation, health estimation, and active control strategies. Using applications alongside practical case studies, each chapter shows the reader how to use the modeling tools provided. Moreover, the chemistry and characteristics are described in detail, with algorithms provided in every chapter. Providing a technical reference on the design and application of Li-ion battery management systems, this book is an ideal reference for researchers involved in batteries and energy storage. Moreover, the step-by-step guidance and comprehensive introduction to the topic makes it accessible to audiences of all levels, from experienced engineers to graduates. Explains how to model battery systems, including equivalent, electrical circuit and electrochemical nernst modeling Includes comprehensive coverage of battery state estimation methods, including state of charge estimation, energy prediction, power evaluation and health estimation Provides a dedicated chapter on active control strategies Lithium-ion batteries (LIBs), as a key part of the 2019 Nobel Prize in Chemistry, have become increasingly important in recent years, owing to their potential impact on building a more sustainable future. Compared with other batteries developed, LIBs offer high energy density, high discharge power, and a long service life. These characteristics have facilitated a remarkable advance of LIBs in many frontiers, including electric vehicles, portable and flexible electronics, and stationary applications. Since the field of LIBs is advancing rapidly and attracting an increasing number of researchers, it is necessary to often provide the community with the latest updates. Therefore, this book was designed to focus on updating the electrochemical community with the latest advances and prospects on various aspects of LIBs. The materials presented in this book cover advances in several fronts of the technology, ranging from detailed fundamental studies of the electrochemical cell to investigations to better improve parameters related to battery packs. Lithium Batteries: Science and Technology is an up-to-date and comprehensive compendium on advanced power sources and energy related topics. Each chapter is a detailed and thorough treatment of its subject. The volume includes several tutorials and contributes to an understanding of the many fields that impact the development of lithium batteries. Recent advances on various components are included and numerous examples of innovation are presented. Extensive references are given at the end of each chapter. All contributors are internationally recognized experts in their respective specialty. The fundamental knowledge necessary for designing new battery materials with desired physical and chemical properties including structural, electronic and reactivity are discussed. The molecular engineering of battery materials is treated by the most advanced theoretical and experimental methods. This book covers all aspects of spent battery collection and recycling. First of all, the legislative and regulatory updates are addressed and the main institutions and programs worldwide are mentioned. An overview of the existing battery systems, of the chemicals used in them and their hazardous properties is made, followed by a survey of the major industrial recycling processes. The safety and efficiency of such processes are stressed. Particular consideration is given to the released emissions, i.e. to the impact on human health and the environment. Methods for the evaluation of this impact are described. Several chapters deal with specific battery chemistries: lead-acid, nickel-cadmium and nickel-metal hydride, zinc (carbon and alkaline), lithium and lithium-ion. For each type of battery, details are provided on the collection/recycling process from the technical, economic and environmental viewpoint. The chemicals recoverable from each process and remarketable are mentioned. A chapter deals with recovering of the large batteries powering electric vehicles, e.g. lead-acid, nickel-metal hydride and lithium-ion. The final chapter is devoted to the important topic of collecting batteries from used electrical and electronic equipment. The uncontrolled disposal of these devices still containing their batteries contributes to environmental pollution. Lithium-Ion Batteries and Solar Cells: Physical, Chemical, and Materials Properties presents a thorough investigation of diverse physical, chemical, and materials properties and special functionalities of lithium-ion batteries and solar cells. It covers theoretical simulations and high-resolution experimental measurements that promote a full understanding of the basic science to develop excellent device performance. Employs first-principles and the machine learning method to fully explore the rich and unique phenomena of cathode, anode, and electrolyte (solid and liquid states) in lithium-ion batteries Develops distinct experimental methods and techniques to enhance the performance of lithium-ion batteries and solar cells Reviews syntheses, fabrication, and measurements Discusses open issues, challenges, and potential commercial applications This book is aimed at materials scientists, chemical engineers, and electrical engineers developing enhanced batteries and solar cells for peak performance. The consequences of drug use, whether illicit or prescribed. Consequences that can be enduring, lifelong, even carry through generations. Yet few of us have the time to consider them as we live in the heat of our own daily lives. I have seen this in action, watched events while they happened, seen it unfold, lived through the results, and unfortunately am observing the ongoing calamities of it all, still today. It is not fun to watch but not mine to fix. I was and am an observer, a recorder, merely that, out of the action, incapable of altering the results. My wife made a great point on this novels subject. Drug use she said is a leveler. It brings people down the lowest common denominator. What a concept! How right on is that statement! Drugs affect the rich, the poor, the famous, and the infamous in every country and nationality on this earth. If you are on the upscale end drugs keep you there. The users life contribution to humanity is likely to be nothing, but the cost to the user, their family and friends in physical, emotional, and fiscal terms expensive and of course dangerous, because it may also kill you. I have put these observations into this novel hoping that readers can identify with the characters, watch them grow and suffer through the consequences of their actions unaware of the effect of their lives and on others. This expert volume addresses the practical challenges which have so far inhibited the commercial realization of a rechargeable magnesium battery, placing the discussion within the context of the already established lithium-ion battery. Lithium-ion batteries are becoming commonplace in most power applications, starting with portable electronics and expanding to motor vehicles, stationary storage, and backup power. Since their introduction 25 years ago, they have slowly been replacing all other battery chemistries. As the technology has matured, it is nearing its theoretical limits in terms of energy density, so research and development worldwide is quickly shifting towards the study of new battery chemistries with cheaper components and higher energy densities. A very popular battery candidate which has generated a lot of recent interest is the magnesium rechargeable battery. Magnesium is five orders of magnitude more abundant than lithium, can move two electrons per cation, and is known to plate smoothly without any evidence of dendritic growth. However, many challenges remain to be overcome. This essential volume presents an unfiltered view on both the realistic promises and significant

obstacles for this technology, providing key insights and proposed solutions. This handbook serves as a guide to deploying battery energy storage technologies, specifically for distributed energy resources and flexibility resources. Battery energy storage technology is the most promising, rapidly developed technology as it provides higher efficiency and ease of control. With energy transition through decarbonization and decentralization, energy storage plays a significant role to enhance grid efficiency by alleviating volatility from demand and supply. Energy storage also contributes to the grid integration of renewable energy and promotion of microgrid. A comprehensive examination of advanced battery management technologies and practices in modern electric vehicles Policies surrounding energy sustainability and environmental impact have become of increasing interest to governments, industries, and the general public worldwide. Policies embracing strategies that reduce fossil fuel dependency and greenhouse gas emissions have driven the widespread adoption of electric vehicles (EVs), including hybrid electric vehicles (HEVs), pure electric vehicles (PEVs) and plug-in electric vehicles (PHEVs). Battery management systems (BMSs) are crucial components of such vehicles, protecting a battery system from operating outside its Safe Operating Area (SOA), monitoring its working conditions, calculating and reporting its states, and charging and balancing the battery system. Advanced Battery Management Technologies for Electric Vehicles is a compilation of contemporary model-based state estimation methods and battery charging and balancing techniques, providing readers with practical knowledge of both fundamental concepts and practical applications. This timely and highly-relevant text covers essential areas such as battery modeling and battery state of charge, energy, health and power estimation methods. Clear and accurate background information, relevant case studies, chapter summaries, and reference citations help readers to fully comprehend each topic in a practical context. Offers up-to-date coverage of modern battery management technology and practice Provides case studies of real-world engineering applications Guides readers from electric vehicle fundamentals to advanced battery management topics Includes chapter introductions and summaries, case studies, and color charts, graphs, and illustrations Suitable for advanced undergraduate and graduate coursework, Advanced Battery Management Technologies for Electric Vehicles is equally valuable as a reference for professional researchers and engineers. This book covers both the fundamental and applied aspects of advanced Na-ion batteries (NIB) which have proven to be a potential challenger to Li-ion batteries. Both the chemistry and design of positive and negative electrode materials are examined. In NIB, the electrolyte is also a crucial part of the batteries and the recent research, showing a possible alternative to classical electrolytes – with the development of ionic liquid-based electrolytes – is also explored. Cycling performance in NIB is also strongly associated with the quality of the electrode-electrolyte interface, where electrolyte degradation takes place; thus, Na-ion Batteries details the recent achievements in furthering knowledge of this interface. Finally, as the ultimate goal is commercialization of this new electrical storage technology, the last chapters are dedicated to the industrial point of view, given by two startup companies, who developed two different NIB chemistries for complementary applications and markets. Polymer-Based Separators for Lithium-Ion Batteries: Production, Processing, and Properties takes a detailed, systematic approach to the development of polymer separators for lithium-ion batteries, supporting the reader in selecting materials and processes for high-performance polymer separators with enhanced properties. The book begins by introducing the polymeric materials that may be used for separators, as well as characterization techniques, before presenting the available technologies used to produce separators for use in lithium-ion batteries. Each technology is discussed in terms of the advantages and disadvantages of the chosen approach, with the properties of the separators made via each technology also summarized and compared in detail. In addition, areas for further development are addressed, and the limitations of current materials and separators in achieving those goals are highlighted. This is a valuable resource for scientists and engineers in the industry who work on polymer-based battery separators, polymers for electronic/energy applications, and new materials and processes for lithium-ion batteries. In academia, this book will be of interest to researchers and advanced students across the fields of polymer science, materials science, electronics, energy, and chemical engineering. Covers all current and new technologies used in the production of polymer battery separators for lithium-ion batteries Analyzes the connections between the various materials and processes, advantages and disadvantages, and resulting properties of different polymer-based separators Enables the reader to develop polymer separators that meet industry standards and property and performance requirements This comprehensive, two-volume resource provides a thorough introduction to lithium ion (Li-ion) technology. Readers get a hands-on understanding of Li-ion technology, are guided through the design and assembly of a battery, through deployment, configuration and testing. The book covers dozens of applications, with solutions for each application provided. Volume Two focuses on small batteries in consumer products and power banks, as well as large low voltage batteries in stationary or mobile house power, telecom, residential, marine and microgrid. Traction batteries, including passenger, industrial, race vehicles, public transit, marine, submarine and aircraft are also discussed. High voltage stationary batteries grid-tied and off-grid are presented, exploring their use in grid quality, arbitrage and back-up, residential, microgrid, industrial, office buildings. Finally, the book explores what happens when accidents occur, so readers may avoid these mistakes. Written by a prominent expert in the field and packed with over 500 illustrations, these volumes contain solutions to practical problems, making it useful for both the novice and experienced practitioners. This second volume discusses state-of-the-art applications of equivalent-circuit models as they pertain to solving problems in battery management and control. Readers are provided information on how to use models from Volume I to control battery packs, along with discussion of fundamental flaws in current approaches. In addition, Volume II introduces the ideas of physics-based optimal battery controls and explains why they can be superior to the state-of-the-art equivalent-circuit controls. Lithium-Ion Batteries: Fundamentals and Applications offers a comprehensive treatment of the principles, background, design, production, and use of lithium-ion batteries. Based on a solid foundation of long-term research work, this authoritative monograph: Introduces the underlying theory and history of lithium-ion batteries Describes the key components of lithium-ion batteries, including negative and positive electrode materials, electrolytes, and separators Discusses electronic conductive agents, binders, solvents for slurry preparation, positive thermal coefficient (PTC) materials, current collectors, and cases Examines the assembly processes and electrochemical performance of lithium-ion batteries Explores applications in power tools, electric vehicles, aerospace, and more Lithium-Ion Batteries: Fundamentals and Applications delivers a systematic overview of lithium-ion batteries, from physical properties to manufacturing technologies. The book also supplies valuable insight into potential growth opportunities in this exciting market. In this book, the most state-of-the-art advanced model-based charging control technologies for lithium-ion batteries are explained from the fundamental theories to practical designs and applications, especially on the battery modelling, user-involved, and fast charging control algorithm design. Moreover, some other necessary design considerations, such as battery pack charging control with centralized and distributed structures, are also introduced to provide excellent

solutions for improving the charging performance and extending the lifetime of the batteries/battery packs. Finally, some future directions are mentioned in brief. This book summarizes the model-based charging control technologies from the cell level to the battery pack level. From this book, readers interested in battery management can have a broad view of modern battery charging technologies. Readers who have no experience in battery management can learn the basic concept, analysis methods, and design principles of battery charging systems. Even for the readers who are occupied in this area, this book also provides rich knowledge on engineering applications and future trends of battery charging technologies. Gaining public attention due, in part, to their potential application as energy storage devices in cars, Lithium-ion batteries have encountered widespread demand, however, the understanding of lithium-ion technology has often lagged behind production. This book defines the most commonly encountered challenges from the perspective of a high-end lithium-ion manufacturer with two decades of experience with lithium-ion batteries and over six decades of experience with batteries of other chemistries. Authors with years of experience in the applied science and engineering of lithium-ion batteries gather to share their view on where lithium-ion technology stands now, what are the main challenges, and their possible solutions. The book contains real-life examples of how a subtle change in cell components can have a considerable effect on cell's performance. Examples are supported with approachable basic science commentaries. Providing a unique combination of practical know-how with an in-depth perspective, this book will appeal to graduate students, young faculty members, or others interested in the current research and development trends in lithium-ion technology. This comprehensive, two-volume resource provides a thorough introduction to lithium ion (Li-ion) technology. Readers get a hands-on understanding of Li-ion technology, are guided through the design and assembly of a battery, through deployment, configuration and testing. The book covers dozens of applications, with solutions for each application provided. Volume One focuses on the Li-ion cell and its types, formats, and chemistries. Cell arrangements and issues, including series (balance) and parallel (fusing, inrush current) are also discussed. Li-ion Battery Management Systems are explored, focusing on types and topologies, functions, and selection. Battery design, assembly, deployment, troubleshooting and repair are also discussed, along with modular batteries, split batteries and battery arrays. Written by a prominent expert in the field and packed with over 500 illustrations, these volumes contain solutions to practical problems, making it useful for both the novice and experienced practitioners. An educational guide that covers all the existing types of lithium battery cells and how to assemble them into a custom lithium battery pack. Lithium-Ion Batteries Hazard and Use Assessment examines the usage of lithium-ion batteries and cells within consumer, industrial and transportation products, and analyzes the potential hazards associated with their prolonged use. This book also surveys the applicable codes and standards for lithium-ion technology. Lithium-Ion Batteries Hazard and Use Assessment is designed for practitioners as a reference guide for lithium-ion batteries and cells. Researchers working in a related field will also find the book valuable. Abstract Lithium-ion batteries allow energy storage with high power and energy density and are widely used for many energy-storage applications. Electric vehicles are one of the most common uses of lithium-ion battery packs and require hundreds or thousands of individual battery cells in a battery pack to power a full-size car. The battery pack requires monitoring by a battery management system (BMS) to guarantee operational safety and optimal usage so the batteries remain healthy as long as possible and must address concerns such as safety and high power demands. To achieve these goals, it is critical to incorporate accurate battery models into BMSs. The goal of this thesis is to show improvements to open-circuit voltage (OCV) estimation and hysteresis modeling for lithium iron phosphate (LFP) battery cells. LFP cells are cheaper and the chemistry make-up is less toxic than many other cell chemistries, but are a challenge to model accurately. This thesis presents a new method to estimate the OCV curve of an LFP battery cell accurately by using rate-of-change for discharge and charge curves from laboratory test data. The method is compared to a resistance-based estimation method and a least-squares optimization method. This thesis also presents two new methods of estimating hysteresis using newly developed Preisach-based models, which are compared to other Preisach-based models. The new OCV method is integrated into an equivalent-circuit model, validated using dynamic lab test data and was found to predict measured cell data better than previous models. The new hysteresis models are simulated and validated with hysteresis lab test data and were found to predict measured cell data better than previous models. One new hysteresis model is integrated into an equivalent-circuit model and simulated to test feasibility of implementation. Multidimensional Lithium-Ion Battery Status Monitoring focuses on equivalent circuit modeling, parameter identification, and state estimation in lithium-ion battery power applications. It explores the requirements of high-power lithium-ion batteries for new energy vehicles and systematically describes the key technologies in core state estimation based on battery equivalent modeling and parameter identification methods of lithium-ion batteries, providing a technical reference for the design and application of power lithium-ion battery management systems. Reviews Li-ion battery characteristics and applications. Covers battery equivalent modeling, including electrical circuit modeling and parameter identification theory Discusses battery state estimation methods, including state of charge estimation, state of energy prediction, state of power evaluation, state of health estimation, and cycle life estimation Introduces equivalent modeling and state estimation algorithms that can be applied to new energy measurement and control in large-scale energy storage Includes a large number of examples and case studies This book has been developed as a reference for researchers and advanced students in energy and electrical engineering. Li-ion battery has dominated the portable electronic market due to its high energy density. Li-ion battery is a complex system where each of its components should be compatible with each other. Polymer binder, although as an inactive component in a cell, plays an important role for battery performance. Polyethylene oxide (PEO) as an ionic conductive polymer has demonstrated its use in gel polymer batteries and solid state batteries. However, there are concerns about its compatibility with layered oxide material as well as stability under high voltage. This thesis studied the compatibility of PEO as a binder for LiNi1/3Mn1/3Co1/3O2 cathode and the stability of PEO up to 4.4V. A comprehensive, accessible introduction to modern all-solid-state lithium-ion batteries. All-solid-state thin-film lithium-ion batteries present a special and especially important version of lithium-ion ones. They are intended for battery-powered integrated circuit cards (smart-cards), radio-frequency identifier (RFID) tags, smart watches, implantable medical devices, remote microsensors and transmitters, Internet of Things systems, and various other wireless devices including smart building control and so on. Comprising four chapters the monograph explores and provides: The fundamentals of rechargeable batteries, comparison of lithium-ion batteries with other kinds, features of thin-film batteries. A description of functional materials for all-solid-state thin-film batteries. Various methods for applying functional layers of an all-solid-state thin-film lithium-ion battery. Diagnostics of functional layers of all-solid-state thin-film lithium-ion batteries. The monograph is intended for teachers, researchers, advanced undergraduate students, and post-graduate students of profile faculties of universities, as well as for developers and manufacturers of thin-film lithium-ion batteries. Starting

out with an introduction to the fundamentals of lithium ion batteries, this book begins by describing in detail the new materials for all four major uses as cathodes, anodes, separators, and electrolytes. It then goes on to address such critical issues as self-discharge and passivation effects, highlighting lithium ion diffusion and its profound effect on a battery's power density, life cycle and safety issues. The monograph concludes with a detailed chapter on lithium ion battery use in hybrid electric vehicles. Invaluable reading for materials scientists, electrochemists, physicists, and those working in the automobile and electrotechnical industries, as well as those working in computer hardware and the semiconductor industry. Here in a single source is an up-to-date description of the technology associated with the Li-Ion battery industry. It will be useful as a text for researchers interested in energy conversion for the direct conversion of chemical energy into electrical energy.